DELIVERING A PUBLIC SECTOR SHARED ARCHITECTURE

REDUCE OPEX AND MITIGATE RISK WITH SHARED MUNICIPAL WIDE AREA NETWORKS

STRATEGIC WHITE PAPER

A multitude of influences are putting sustained pressure on state and local governments to find innovative ways to modernize information communications infrastructure. Aging city-wide infrastructure needs to be transformed to ensure sustainable, reliable, anytime connectivity for citizens and agencies alike.

An intelligent communications network for shared use among different agencies offers a framework to conserve financial and manpower resources by building a resilient, flexible, scalable and secure network foundation.

This paper discusses the benefits of modernizing your city communications infrastructure. Learn about:

- Planning for the evolution to a cloud-based architecture with minimal network impact
- Building a resilient and cost-effective wide area network architecture for robust disaster preparedness
- Simplifying network management while enhancing agility in service provisioning
- Creating an ROI model that quantifies the business drivers and benefits of shared municipal wide area networks
- Identifying and mitigating business and technology risks

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INTRODUCTION

The objective of this paper is to examine how public sector bodies can achieve savings and increase efficiencies from a shared-services approach through the deployment of the Alcatel-Lucent communications architecture.

Many influences are putting sustained pressure on state and local governments to find innovative ways to modernize information communications infrastructure. Some of those influences are:

- Rapidly growing urban populations
- Stringent environmental regulations
- Greater expectations from constituents
- Increasing budget constraints

Aging city-wide infrastructure needs to be transformed to ensure sustainable, reliable, anytime connectivity for citizens and agencies alike.

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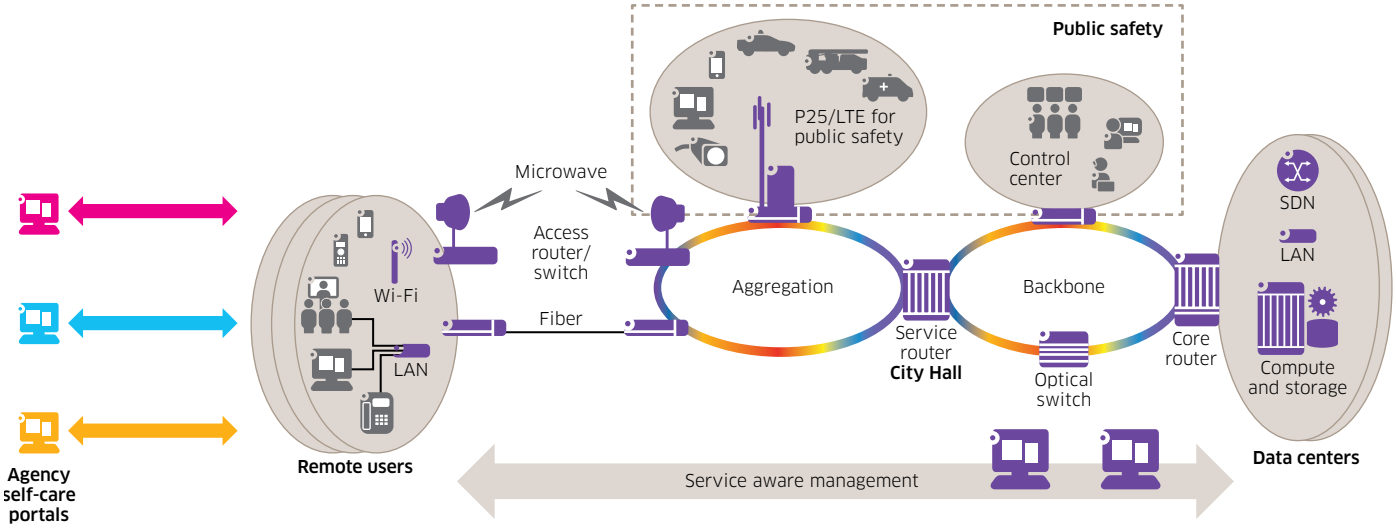
This paper discusses the benefits of modernizing your city communications infrastructure. Learn about:

- Building a resilient and cost-effective wide area network (WAN) architecture for robust disaster preparedness
- Simplifying network management while enhancing agility in service provisioning
- Creating a return on investment (ROI) model that quantifies the business drivers and benefits of shared municipal WANs
- Identifying and mitigating business and technology risks
- Planning for the evolution to a cloud-based architecture with minimal network impact

Alcatel-Lucent is working with a mix of local and regional public sector organizations to deliver services across a single centrally managed data infrastructure to help the organizations meet operational- and financial-efficiency targets.

Figure 1 shows a shared architecture system that utilizes all the transport mechanisms at an organization's disposal. By implementing secure reliable technologies in the network like IP with Multiprotocol Label Switching (IP/MPLS) and network management to simplify provisioning, the network achieves low operational cost, high availability, flexibility and security.

Figure 1. Shared architecture for public sector



An architecture that exceeds performance requirements for mission-critical traffic

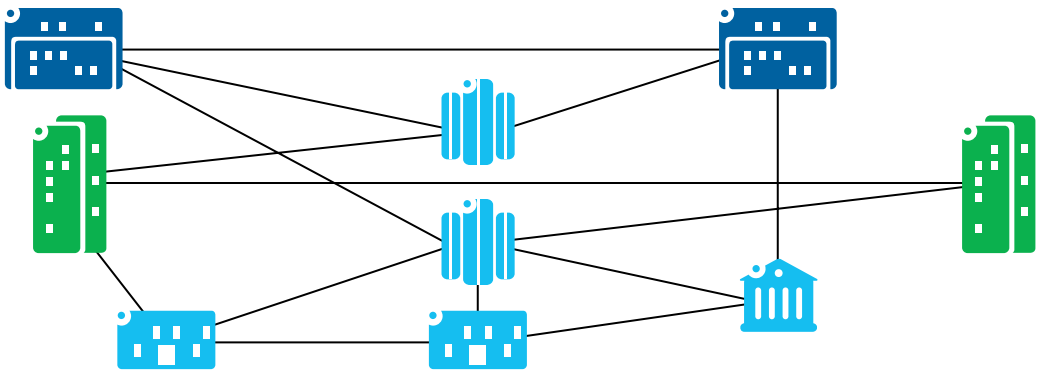
RESILIENT AND SECURE WANS

Building a resilient, secure and cost-effective WAN architecture for robust disaster preparedness

Today's networks may contain point-to-point connections similar to those in Figure 2, and have grown up over time, expanding by need or necessity without too much thought going into how those additional links will behave during an incident or disaster that takes down key links. Conventional wisdom has brought us to the point where these additional links join the network, consuming more equipment ports and physical transport facilities. Legacy equipment and protocols have to be considered and their data transported. In many observed cases, multiple data lines come into shared facilities, increasing operational costs and contributing to data transport inefficiency. Consolidating or converging these lines to a high-bandwidth transport mechanism such as fiber or microwave will reduce overall costs, provide security for served customers and standardize data transport across the network.

Figure 2 shows a point-to-point network configuration. Note that if a single link goes down, many others are affected.

Figure 2. Point-to-point connections

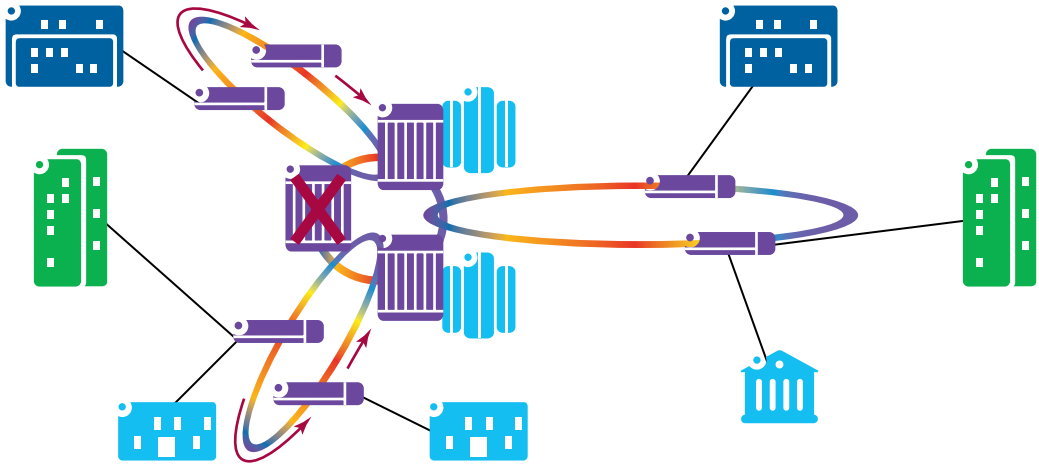


Point-to-point connections satisfy connectivity with multiple links

Links can be consolidated to data centers and major fiber points of presence and optimized for agency and government communications efficiency. Metro rings can be added for aggregation and reliability (Figure 3).

When a link drops, data service beyond the link in a conventional network is disrupted for the duration of the outage. Building in resilience by adopting the CityNet concept, a shared services municipal network using IP/MPLS, reduces reliance on point-to-point links, enabling automatic data path recovery. Additional savings can be realized by converging data service requirements into CityNet, keeping each user's data separate and secure through the use of virtual private networks (VPNs) over common transport paths.

Figure 3. Flexible connectivity and increased reliability



CityNet approach yields flexible connectivity and increased service reliability

Legacy protocols can be converted to IP/MPLS, and routed through the network as packet traffic. At the other end of the connection, conversion back to the original protocol is completed. The legacy equipment can operate without interruption and users can enjoy the same level of service at lower cost and over a resilient network. An example of utilizing CityNet for this purpose is in Public Safety Land Mobile Radio.

Many of these systems rely on TDM-based transmission protocols like a T1 line to ensure delivery of the signal to the system at the right time and channel. Maintaining those TDM circuits and paying for essentially a low data rate transmission instead of moving to a more cost-effective high data rate connection is not the best utilization of those links. Converting to IP/MPLS and transporting the data across CityNet reduces monthly recurring costs and allows the legacy system to operate into the future without the need to change anything in it.

Situational Awareness is another area that CityNet can help improve. Accessing data during an incident or event can stress a traditional network, overloading connection paths and impeding traffic management. Implementation of the CityNet strategy can prioritize traffic, increase bandwidth where needed, and enable use of cloud data and applications.

In the event of a disaster at a data center or a disruption of service, CityNet "kicks in" with redundant routing. Multiple paths for data delivery are assigned in the architecture, by definition; each packet has to have a redundant and resilient path from end to end.

Disruptions are minimized and can be dealt with easily and quickly. Down time is reduced, and managing repairs is less costly. Coupling CityNet with a network management software scheme multiplies the effectiveness of CityNet.

SIMPLIFY NETWORK MANAGEMENT

Simplifying network management while enhancing agility in service provisioning

Once the architecture for the network is defined, it is important to think about how to provision and manage it. The Alcatel-Lucent 5620 Service Aware Manager (SAM) and the Service Portal used in combination enable network management simplicity and flexibility. The 5620 SAM is the network management software that monitors and controls traffic on the network as well as examining the health of the network. The Service Portal or Service Portal Express (SPE) is a window into the management software that simplifies provisioning and many of the repetitive tasks that often increase network maintenance costs. SPE enables the network operator to configure circuits and permissions through a GUI, avoiding manufacturer-specific Command Line Instruction (CLI) programming.

SPE enables staff who are not specialists in networking to provision circuits by following scripts to set up connections. The new data paths are validated by the software and checked live for veracity. The new path can then be approved by an engineer prior to provisioning, which simplifies the process and reduces reliance on CLI experts. The Service Portal contains the knowledge to program any manufacturer's equipment as long as it meets some basic requirements. This allows the network manager to focus on managing the network instead of worrying about where each command line instruction is going.

The 5620 SAM offers the ability to monitor network health, while keeping human managers informed of alarms and conditions. Coupled with CityNet and the IP/MPLS network mentioned earlier, the entire system can anticipate problems, watch for degradation and inform management of changes and problems. In the event of a disaster, network provisioning can be handled by a "tiger team" of non-specialists, getting data back on the network rapidly and efficiently. In one particular case, provisioning after a major disaster took days instead of months. When down time costs thousands of dollars per hour, the cost savings is huge.

ROI MODEL FOR THE WAN

Creating an ROI model that quantifies the business drivers and benefits of shared municipal WANs

This case study compares the business benefits of CityNet with a legacy point-to-point fiber network. Consider a city facing the following challenges:

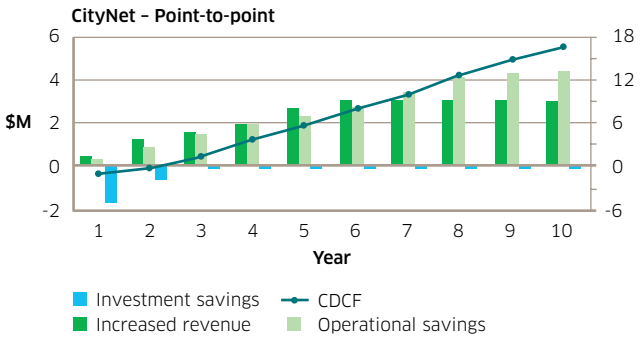
- A growing demand for connectivity and more bandwidth from city agencies
- A limited network of point-to-point fiber. The network was equipped with a variety of legacy technologies.
- An operations staff, most of whom were retiring

In addition, the city desired a solution that accommodated the following needs:

- An agile and resilient network that could accommodate the higher bandwidth apps, as well as the Internet of Things, such as traffic controllers, bus stops, water services and security cameras
- A unified network management system (for the network operations center) and a partitioned network management system to provide city agencies with autonomous control
- Plan to sell more dark fiber to help offset the cost of the network deployment

The city asked whether a converged, shared services CityNet was more economical than a point-to-point network. Alcatel-Lucent Bell Labs developed a business model that compared CityNet with their legacy point-to-point fiber network. The business model showed that CityNet achieved Payback in 2.3 years over their legacy point-to-point fiber network, as shown in Figure 4.

Figure 4. Business modeling results comparing CityNet with point-to-point



CATEGORY	10 YEARS TOTAL ($M)
Increased revenue	$22.54
Operational savings	$25.18
Investment savings	$-3.17
NPV	$16.68
Payback	2.3 years

CityNet investment enables more connection points, more revenue, less OPEX

The key areas of benefits from the CityNet business model were as follows:

- Enabled agencies to deploy their own high-speed services (up to 1 Gb/s) to users in a matter of hours, versus the legacy system taking 6 weeks per circuit
- Enabled 12 times as many Internet of Things devices to be deployed over the same amount of fiber, through the use of IP/MPLS
- Enabled a bandwidth-based, distance-insensitive cost model to be used with agencies, which simplified budget planning and encouraged additional deployment of services
- Enabled the sale of additional dark fiber, generating an additional $22 million in external revenue
- Provided a resiliency benefit of 6 days faster recovery and over $3 million in savings following a natural disaster versus the same scenario with the legacy network
- Enabled the city to double their workload without hiring additional IT operations staff

SHARED RISK MITIGATION

Identifying and mitigating business and technology risks

Creating a shared services network like the CityNet framework also comes with additional risk elements. The network must be able to provide a secure, reliable and scalable service that meets or exceeds the combined requirements of each tenant's applications and services. This can be successfully accomplished with the MPLS technology and management tools built into the CityNet design. Fundamentally, support for a shared architecture model comes with three key requirements:

1. Traffic isolation
2. Address independence
3. Flexible application placement and migration

The MPLS overlay model in the CityNet architecture provides VPNs to provide the required traffic isolation. Since each agency is virtually isolated from others, they are free to use whatever address scheme meets their application requirements. Many times the individual agencies will not even need to change existing addresses. Combining multiple tenants with MPLS gives CityNet network operators a great deal of flexibility to divert and route traffic around link failures, congestion and bottlenecks while assuring each tenant's individual service level agreements (SLAs).

Since each agency application can have its own use case on the network that is separate from any adjacent use cases, applications required to reside inside of a tenant's network will easily co-exist with other tenants' applications. There will be no interactions between use cases without going through a control point or location (that is, a firewall for L3/L4 traffic or a data control center for L2 traffic). Since MPLS maintains a separate management, control and data plane, each group is a closed system that isolates its functions from access outside the group and between each group. The isolation of traffic of one closed user group from other groups adds to the network security and facilitates flexibility in implementing security and other requirements individually for each group. The protocols used between endpoints within a closed user group can be different from the protocol used within another group. With MPLS, protection mechanisms ensure that reliability requirements are met and that failures can be recovered within specified time limits. With the combination of MPLS and DiffServ (or class-aware traffic engineering), services can be prioritized for traffic on a per-class basis (QoS classes).

The flexibility to offer each tenant various levels of security, resilience and scale over a unified management infrastructure clearly helps the CityNet framework deliver value for each agency while mitigating shared technology risks.

CLOUD ADOPTION

Planning for the evolution to a cloud-based architecture with minimal network impact

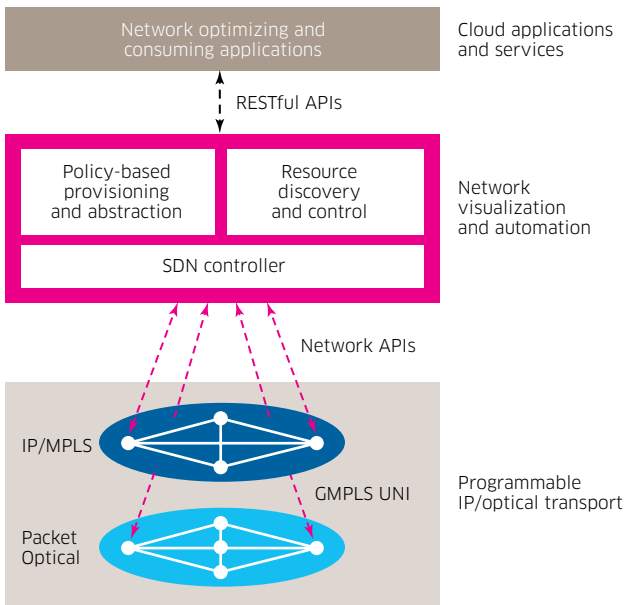
Over the next few years, governments will prepare their data centers and WANS for cloud-optimized services and networking. This will include the adoption of Software Defined Networking (SDN) for the delivery of cloud applications and services. A multi-layer SDN framework is essential in the delivery of cloud-based routing and transport required in this transition.

Cloud computing is the evolution of the traditional static IT model into a dynamic, "utility-like" on demand model. This allows public sector organizations to automatically activate and de-activate resources as needed, dynamically update infrastructure elements and move workloads to improve efficiency without having to worry about creating new infrastructures for each new application.

Cloud computing also creates the opportunity for government IT and individual agency operations to create a shared multi-tenant framework for individual agencies or groups to consume resources according to their customer needs. The elasticity provided in the cloud computing with SDN provides a secure and extensible platform that allows use of resources both internally and externally of the government's data center and network boundaries. Cloud computing is fundamentally a service paradigm. Transformation to the cloud is ideal for the shared or multi-tenant operations typical of a multi-agency government.

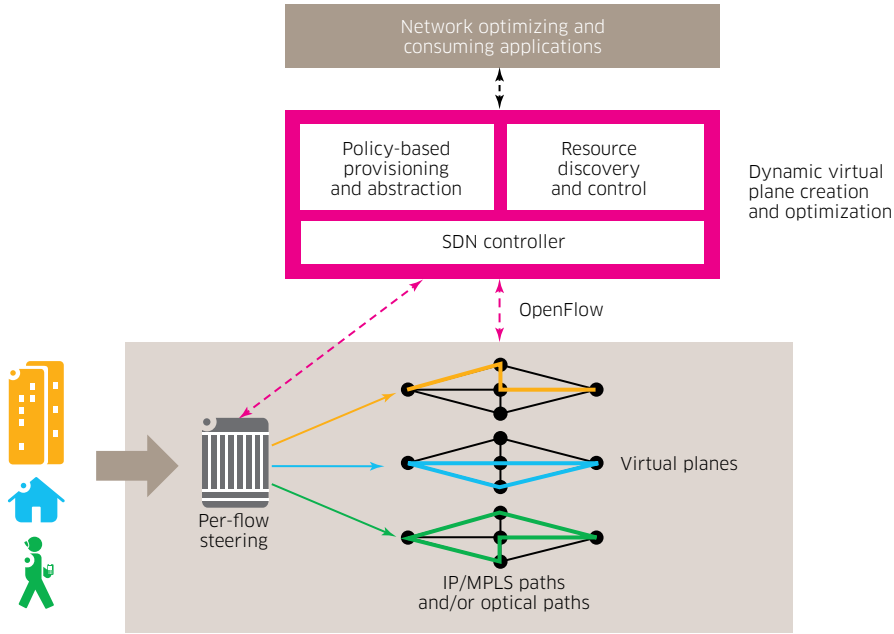
Preparing the network for the cloud requires creating the multilayer SDN framework that further partitions CityNet networks into two major components: network virtualization and automation and programmable IP/MPLS/optical transport. This means that the new cloud-optimized framework is a logical extension of the IP/MPLS-based CityNet architecture discussed throughout this document. The ability of MPLS to communicate with an SDN layer to remove roadblocks to cloud adoption exists today in Alcatel-Lucent products. The high-level capabilities are outlined in Figure 5.

Figure 5. Cloud optimized CityNet architecture with SDN



This means that governments can create and manage the multilayer, traffic-engineered services that meet the SLAs of each agency's set of applications. Policies can be created to dynamically map traffic identified by agencies to the appropriate service plane, as shown in Figure 6.

Figure 6. Traffic flow-optimized service planes



To speed up service provisioning, governments need to eliminate the errors and delays associated with manual coordination of multiple provisioning systems (per layer and/or per vendor), or with wholly manual provisioning processes. The transformation of the CityNet architecture into an easily consumable resource for applications creates a fertile environment for the rapid evolution of new, usage-based IT and network services.

CONCLUSION

Adoption of Alcatel-Lucent's CityNet architecture will provide a secure, scalable and resilient network-unified management value while it reduces operational costs. Alcatel-Lucent's family of products utilized in the CityNet design integrates smoothly together to create a successful framework for shared service delivery. Therefore, managing the network becomes easier and less dependent on high-cost experts.

Recovering from a disaster or network interruption is eased by the redundant and resilient nature of the network. IP/MPLS and the network management system work together to find usable paths instantly, while informing managers where to go to repair outages. Provisioning is simplified through the use of the Service Portal, and provisioning backup circuits or workarounds during a disaster or incident is simplified through the use of predefined scripts and permissions.

Implementation of CityNet has a proven ROI that quickly produces payback for the capital invested — typically less than three years.

The flexibility to offer each tenant various levels of security, resilience and scale over a unified management infrastructure clearly helps the CityNet framework deliver value for each agency while mitigating shared technology risks.

Finally, the CityNet architecture becomes an essential first step as governments prepare their data centers and WANs for cloud-optimized services, networking and FirstNet. The architecture is very well suited for cloud computing requirements, including distributed data retrieval and storage. CityNet provides resilient paths to access applications and data that may be in dispersed locations. To the end user the network is transparent. For the manager of the cloud resources, the network enables simple and robust connections with dynamic traffic control. Mirrored data and application support is easily achieved through the cloud and CityNet.

ACRONYMS

CityNet	A secure, reliable and intelligent network architecture
CLI	Command Line Instruction
DiffServ	Differentiated Services – Classes of traffic flows
MPLS	Multiprotocol Label Switching
OPEX	operating expenditures
QoS	Quality of Service
ROI	return on investment
SAM	Service Aware Manager
SDN	Software Defined Networking
SLA	Service Level Agreement
SPE	Service Portal Express – an Alcatel-Lucent network management product
TDM	Time Division Multiplexing
VPN	virtual private network
WAN	wide area network

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- http://www2.alcatel-lucent.com/government/
- http://www2.alcatel-lucent.com/public-safety/

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